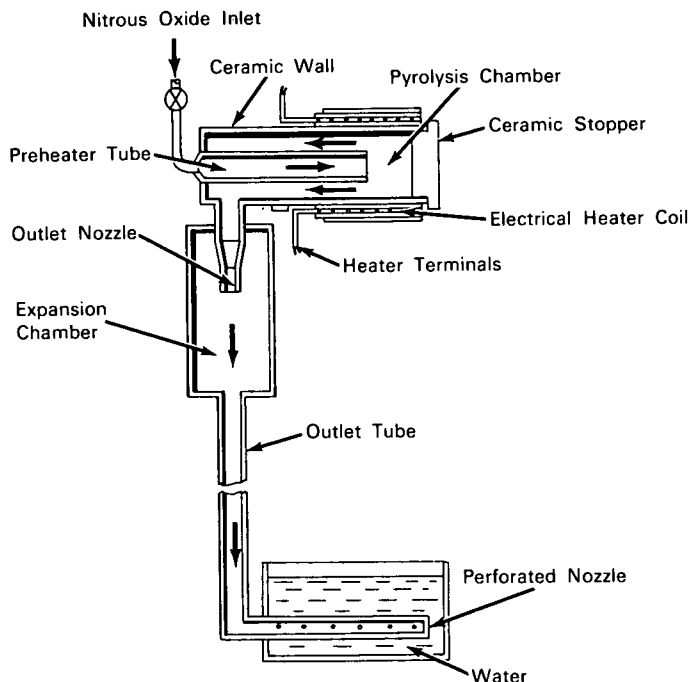


NASA TECH BRIEF



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Nitrogen Dioxide Produced by Self-Sustained Pyrolysis of Nitrous Oxide



The problem: Developing a method for continuous production of nitrogen dioxide by pyrolysis (thermal decomposition) of nitrous oxide, without the continued application of heat. In one continuous method of nitrous oxide pyrolysis that has been reported, it is necessary to add heat to the tube in which the pyrolysis is conducted in order to maintain the reaction at the proper equilibrium temperature. Without an auxiliary source of heat, the continuous entry of cool nitrous oxide into the reaction tube will drastically slow down or stop the reaction.

The solution: An apparatus in which the nitrous oxide feed is regeneratively heated by the gases

produced in a pyrolysis chamber to achieve a continuous self-sustaining reaction.

How it's done: The apparatus includes a preheater tube through which pressurized nitrous oxide flows into a ceramic pyrolysis chamber, external electrical heating coils that are turned on for a brief time to start the reaction, an expansion chamber to cool the gaseous products, and an outlet tube terminated by a perforated nozzle that leads into a tank of water where the gases are further cooled and the nitrogen dioxide is absorbed.

The operation is started by applying heating current to the coils until the ceramic stopper and approximately one-half the ceramic tube adjacent to it attains

(continued overleaf)

a bright-red color. Nitrous oxide at a pressure of approximately 25 atmospheres is then introduced into the preheater tube. The nitrous oxide emerges from the end of this tube into the pyrolysis chamber and impinges on the hot stopper surface where the flow is reversed and the gas comes into contact with the hot wall of the pyrolysis chamber. As a result of the contact with the heated surfaces, the nitrogen dioxide decomposes and liberates its heat of formation. The resulting pressure increase and turbulence force the gaseous decomposition products against the ceramic stopper which is thus heated to a sufficient temperature to continue decomposition of the inflowing nitrous oxide striking the stopper. As soon as this condition is reached, the current is cut off from the heater and the process becomes self-sustaining, both because of the exothermic reaction and the counter-current regenerative heating of the nitrous oxide feed in the preheater tube. The hot gaseous products leave the pyrolysis chamber through the outlet nozzle. These gases include nitrogen dioxide, nitrogen, oxygen, and undecomposed nitrous oxide. The exhaust gases are partially cooled in the expansion chamber and further by bubbling them through water, from which the nitrogen dioxide is recovered as nitric acid.

Notes:

1. The rate of exhaust gas cooling is an important factor in determining the percentage of nitrogen dioxide recovery. Cooling control can be achieved

by adjusting the shape of the outlet nozzle and its position along the pyrolysis chamber. The dimensions of the expansion chamber and the rate of flow of the gas through the apparatus can also be varied to control the rate of cooling of the nitrogen dioxide.

2. The principle of the apparatus can be applied to maintain continuous exothermic pyrolysis of any gases which have a sufficiently high heat of reaction.
3. Inquiries concerning this invention may be directed to:

Technology Utilization Officer
Langley Research Center
Langley Station
Hampton, Virginia, 23365
Reference: B65-10074

Patent status: NASA encourages the commercial use of this invention. It was invented by a NASA employee, and U.S. Patent No. 2,974,019 has been issued to him. Inquiries about obtaining license rights for its commercial development should be addressed to the inventor, Mr. Alexander P. Sabol, Langley Research Center, Langley Station, Hampton, Virginia, 23365.

Source: Alexander P. Sabol
(Langley 32)